

NFPA®

805

Performance-Based Standard for
Fire Protection for Light Water
Reactor Electric Generating Plants

2020



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NFPA® 805

Performance-Based Standard for

Fire Protection for Light Water Reactor Electric Generating Plants

2020 Edition

This edition of NFPA 805, *Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants*, was prepared by the Technical Committee on Fire Protection for Nuclear Facilities. It was issued by the Standards Council on November 4, 2019, with an effective date of November 24, 2019, and supersedes all previous editions.

This edition of NFPA 805 was approved as an American National Standard on November 24, 2019.

Origin and Development of NFPA 805

The 2001 edition of NFPA 805 was the first edition of this standard. NFPA 805 replaced NFPA 803, *Standard for Fire Protection for Light Water Nuclear Power Plants*. NFPA 805 is a performance-based standard that describes the methodology for applying performance-based requirements, fundamental fire protection program design and elements, determination of fire protection systems and features, and fire protection during decommissioning and permanent shutdown of light water reactor electric generating plants.

The 2006 edition was reformatted to comply with the *Manual of Style for NFPA Technical Committee Documents* and to incorporate new information from the EPRI Fire Modeling Guide and NUREG 1805.

The 2010 edition was revised to coordinate with the new NFPA 806, *Performance-Based Standard for Fire Protection for Advanced Nuclear Reactor Electric Generating Plants Change Process*. Personnel considerations were removed from the methodology for defining the fire scenario because, as a life safety issue, they do not belong as a component.

The 2015 edition was revised to include the definitions and requirements from NFPA 101 and NFPA 1144 on combustible, noncombustible, and limited-combustible materials. The references to NFPA 256 and NFPA 251 were removed because these standards were withdrawn.

The 2020 edition has been revised to include additional language from NFPA 101 that more clearly identifies materials that should be considered limited-combustible. Annex language has also been added to expand on issues that exist in the selection of suppression systems that can lead to thermal shock.

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Committee Scope: This Committee shall have primary responsibility for documents on the safeguarding of life and property from fires in which radiation or other effects of nuclear energy might be a factor.

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NFPA 805

Performance-Based Standard for

Fire Protection for Light Water Reactor
Electric Generating Plants

2020 Edition

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced and extracted publications can be found in Chapter 2 and Annex F.

Chapter 1 Administration

1.1 Scope. This standard specifies the minimum fire protection requirements for existing light water nuclear power plants during all phases of plant operation, including shutdown, degraded conditions, and decommissioning.

1.2 Purpose. Protecting the safety of the public, the environment, and plant personnel from a plant fire and its potential effect on safe reactor operations is paramount to this standard. The fire protection standard shall be based on the concept of defense-in-depth. Defense-in-depth shall be achieved when an adequate balance of each of the following elements is provided:

- (1) Preventing fires from starting
- (2) Rapidly detecting fires and controlling and extinguishing promptly those fires that do occur, thereby limiting fire damage
- (3) Providing an adequate level of fire protection for structures, systems, and components important to safety, so that a fire that is not promptly extinguished will not

prevent essential plant safety functions from being performed

1.3 Goals.

1.3.1 Nuclear Safety Goal. The nuclear safety goal shall be to provide reasonable assurance that a fire during any operational mode and plant configuration will not prevent the plant from achieving and maintaining the fuel in a safe and stable condition.

1.3.2 Radioactive Release Goal. The radioactive release goal shall be to provide reasonable assurance that a fire will not result in a radiological release that adversely affects the public, plant personnel, or the environment.

1.3.3* Life Safety Goal. The life safety goal shall be to provide reasonable assurance that loss of life in the event of fire will be prevented for facility occupants.

1.3.4 Plant Damage/Business Interruption Goal. The plant damage/business interruption goal shall be to provide reasonable assurance that the risks of fire are acceptable with regard to potential economic consequences.

1.4 Performance Objectives.

1.4.1 Nuclear Safety Objectives. In the event of a fire during any operational mode and plant configuration, the plant shall be provided with the following:

- (1) Reactivity control, which is the capability of rapidly achieving and maintaining subcritical conditions
- (2) Fuel cooling, which is the capability of achieving and maintaining decay heat removal and inventory control functions
- (3) Fission product boundary, which is the capability of preventing fuel clad damage so that the primary containment boundary is not challenged

1.4.2 Radioactive Release Objective. Either of the following objectives shall be met during all operational modes and plant configurations:

- (1) Containment integrity is capable of being maintained.
- (2) The source term is capable of being limited.

1.4.3 Life Safety Objectives. The life safety objectives shall be to protect occupants not intimate with the initial fire development from loss of life and improve the survivability of those who are intimate with the fire development, as well as to provide protection for essential and emergency personnel.

1.4.4 Plant Damage/Business Interruption Objectives. In order to meet the plant damage/business interruption goals, the following objectives shall be met during all operational modes and plant configurations.

- (1) Potential property damage due to fire shall be limited to an acceptable level as determined by the owner/operator.
- (2) Potential business interruption (plant downtime) due to fire shall be limited to an acceptable level as determined by the owner/operator.

1.5 Performance Criteria.

1.5.1 Nuclear Safety Performance Criteria. Fire protection features shall be capable of providing assurance that, in the event of a fire, the plant is not placed in an unrecoverable condition.

1.5.2 To demonstrate the capability required by 1.5.1, the following performance criteria shall be met:

- (1) *Reactivity Control*. Reactivity control shall be capable of inserting negative reactivity to achieve and maintain subcritical conditions, and inserting shall occur rapidly enough such that fuel design limits are not exceeded.
- (2) *Inventory and Pressure Control*. With fuel in the reactor vessel, head on and tensioned, inventory and pressure control shall be capable of the following:
 - (a) Controlling coolant level such that level indication is maintained in the pressurizer for a pressurized water reactor (PWR)
 - (b) Maintaining or rapidly restoring reactor water level above the top of active fuel for a boiling water reactor (BWR) such that fuel clad damage as a result of a fire is prevented
- (3) *Decay Heat Removal*. Decay heat removal shall be capable of removing sufficient heat from the reactor core or spent fuel such that fuel is maintained in a safe and stable condition.
- (4) *Vital Auxiliaries*. Vital auxiliaries shall be capable of providing the necessary auxiliary support equipment and systems to ensure that the systems required under 1.5.2(1), 1.5.2(2), 1.5.2(3), and 1.5.2(5) are capable of performing their required nuclear safety function.
- (5)* *Process Monitoring*. Process monitoring shall be capable of providing the necessary indication to ensure that the criteria addressed in 1.5.2(1) through 1.5.2(4) have been achieved and are being maintained.

1.5.3 Radioactive Release Performance Criteria. Radiation release to any unrestricted area due to the direct effects of fire suppression activities (but not involving fuel damage) shall be as low as reasonably achievable and shall not exceed applicable 10 CFR 20 limits.

1.5.4 Life Safety Criteria. The following performance criteria shall be met during all operational modes and plant configurations:

- (1) Provision of safe egress and/or area of refuge for occupants other than essential personnel
- (2) Provision of protection, including emergency lighting, for essential personnel to perform necessary safety functions as a result of a fire event
- (3) Provision of protection for essential personnel, providing necessary emergency services during or following a fire

1.5.5* Plant Damage/Business Interruption Criteria. In order to meet the individual plant damage/business interruption objectives, the following criteria shall be satisfied:

- (1) The probable maximum loss (PML) shall not exceed an acceptable level as determined by the owner/operator.
- (2) The business interruption (plant downtime) due to a PML fire event shall not exceed an acceptable level as determined by the owner/operator.

1.6 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard.

1.6.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.6.2 The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

1.7 Code of Record. The codes and standards referenced in this standard refer to the edition of the code or standard in effect at the time the fire protection systems or feature was designed or specifically committed to the authority having jurisdiction.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 10, *Standard for Portable Fire Extinguishers*, 2018 edition.

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*, 2018 edition.

NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*, 2018 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2019 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2019 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2017 edition.

NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*, 2019 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2019 edition.

NFPA 22, *Standard for Water Tanks for Private Fire Protection*, 2018 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2019 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2018 edition.

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, 2019 edition.

NFPA 55, *Compressed Gases and Cryogenic Fluids Code*, 2020 edition.

NFPA 72®, *National Fire Alarm and Signaling Code®*, 2019 edition.

NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, 2019 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, 2018 edition.

NFPA 101®, *Life Safety Code®*, 2018 edition.

NFPA 220, *Standard on Types of Building Construction*, 2018 edition.

NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, 2019 edition.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, 2018 edition.

NFPA 600, *Standard on Facility Fire Brigades*, 2020 edition.

NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*, 2019 edition.

NFPA 750, *Standard on Water Mist Fire Protection Systems*, 2019 edition.

NFPA 1500™, *Standard on Fire Department Occupational Safety, Health, and Wellness Program*, 2020 edition.

NFPA 1582, *Standard on Comprehensive Occupational Medical Program for Fire Departments*, 2018 edition.

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*, 2018 edition.

2.3 Other Publications.

2.3.1 ASME Publications. American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990.

ASME B31.1, *Power Piping*, 2016.

2.3.2 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 2018.

ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, 2018.

ASTM E136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C*, 2016.

ASTM E2652, *Standard Test Method for Behavior of Materials in a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750 Degrees C*, 2016.

ASTM E2965, *Standard Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter*, 2016.

2.3.3 NRC Publications. US Nuclear Regulatory Commission, Public Document Room, Washington, DC 20555-0001.

Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant Specific Changes to the Licensing Basis."

Generic Letter 86-10, Supplement 1, "Fire Endurance Test Acceptance Criteria for Fire Barrier Systems Used to Separate Safe Shutdown Trains Within the Same Fire Area."

Generic Letter 86-10, Supplement 1, Attachment 1, "Attachment Methods for Demonstrating Functionality of Cables Protected by Raceway Fire Barrier Systems During and After Fire Endurance Test Exposure."

Δ 2.3.4 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 723, *Standard for Test for Surface Burning Characteristics of Building Materials*, 2008, revised 2013.

2.3.5 US Government Publications. US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation."

Title 10, Code of Federal Regulations, Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix R to Part 50, Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979.

2.3.6 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections.

NFPA 101®, *Life Safety Code*®, 2018 edition.

NFPA 1144, *Standard for Reducing Structure Ignition Hazards from Wildland Fire*, 2018 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.2.7 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase "standards development process" or "standards development activities," the term "standards" includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.